

**Taxing Marijuana and the Road to Reparations:  
Comparing the Colorado and Illinois Cannabis Markets**

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## **Abstract**

Although still prohibited at the federal level, cannabis can now be found on the shelves of recreational dispensaries across thirty-three U.S states. This thesis examines the development of this legal market from both historical and empirical perspectives. Using a new data set, it estimates the determinants of cannabis sales and tax revenues in the Colorado market and analyzes the incidence of a single tax increase. The results, which suggest that legal cannabis behaves like a luxury good, are used to analyze the potential for cannabis-funded reparations programs in Illinois, which recently approved recreational sales of cannabis.

*JEL classification:* H20, R50, L15

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## I. Introduction

Cannabis, a botanical product famous for its psychoactive properties, is the most commonly consumed illegal substance in the world (Mary Barna Bridgeman, 2017). However, what was considered a dangerous drug for most of the past century in the United States, is now being treated like a product. As of January 1st, 2020 - Cannabis is available in thirty-three U.S. states for medical use, and in eleven for recreational use<sup>1</sup> (Jeremy Berke, 2020). Since 1996, when California was the first state to legalize cannabis for medical use, high demand and constant growth have led the market to be forecasted to become the next “Big Tobacco” (Mary Barna Bridgeman, 2017). New Frontier Data, a D.C. based cannabis researcher, estimates that 38.4 million U.S. adults consume cannabis at least once annually, from either the unregulated or legal market. Most of these users are either daily (36%) or weekly smokers (59%)<sup>2</sup>. The widespread and frequent use of cannabis translated in \$13.6 billion in sales in the legalized market through 2019. Of these, \$6 billion came from the medical cannabis market and \$7.6 billion from recreational sales. Overall, market revenue increased by 32% since 2018, and it is projected to reach \$30 billion by 2025 (New Frontier Data, 2019). These projections suggest that, despite the many barriers to entry, the market has grown rapidly and consistently in the 24 years since California pioneered the medical market.

Market projections for 2025 rely heavily on the assumption that more states will join the movement of legalization for either medical or recreational use. While this is likely, considering the thirty-three states that have already joined the “green rush” in the last few years, it also highlights the heftiest barrier that cannabis businesses have to face. While legalized in thirty-

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<sup>1</sup> Recreational use – need to be 21 years old or over in every state. Regulations on quantity possessed varies based on state.

three states and decriminalized in fifteen, cannabis remains a Schedule I drug at the federal level (Lopez, 2019; United States Drug Enforcement Administration, 2020). This classification has led to the formation of several barriers to entry into the legal cannabis market. The first obstacle that cannabis businesses need to face, especially direct-to-consumer sellers, is that cannabis is predominantly a cash-only business<sup>3</sup> (Varian, 2018). Another barrier is the impossibility to transport THC<sup>4</sup> products across state borders, which impacts growers, dispensaries, product manufacturers, and consumers. This might not seem limiting at first, considering that each state is allowed to grow cannabis and therefore distribute within its borders; however, dispensaries in states with a shorter history of legalization tend to struggle to differentiate their product offering. Since all businesses rely on a limited number of suppliers, most dispensaries are unable to differentiate and create a brand identity based on product line. Lastly, the most significant consequence of the lack of federal legalization can be found in taxation.

U.S. states are given the freedom to create their terms of cannabis legalization and tax the market independently from the federal government. Consequently, taxation across states differs widely both in terms of tax rates and utilization. Tax rates range from 0 percent, in the case of Delaware - where only medical cannabis is legalized - to up to 48.25 percents, in the case of Illinois - which began recreational legalization January 1st, 2020 (Delaware.gov, 2020; Berg, 2020). Similar to tax rates, how tax revenue is distributed also varies by state. Colorado, for instance, redirects cannabis tax revenue towards its Public School Fund and the Marijuana Tax Cash Fund, which is used to finance health care, health education, substance abuse prevention

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<sup>3</sup> Because the federal government considers marijuana an illicit substance, many banks and financial services providers will not work with cannabis companies out of fear of being charged with money launderings (Varian, 2018).

<sup>4</sup> THC is the main psychoactive constituent in cannabis products

<sup>5</sup> This is obtained by considering the purchase of a cannabis product with a THC level above 35% and compounding a 7% wholesale tax, which, even if further up the supply chain, will eventually be passed down to customers.

and treatment programs, and law enforcement (Paul, 2019). Most states follow a similar taxation model, funding healthcare, education, or public safety programs through tax revenue. However, Illinois shook the cannabis world in 2020 with a different tax proposition (Tax Policy Center, 2020). Chicago's home state will direct 35 percent of cannabis tax revenue to the General Revenue Fund, 20 percent to the Department of Human Services Community, and, most importantly, 25 percent to the R3 program. Part of the Criminal Justice Information Project Fund, the *Restore, Reinvest, and Renew* (R3) program has been designed to address the catastrophic impact that the War on Drugs and the consequent phenomenon of mass incarceration had on communities of color in Illinois (Illinois.gov, 2020). Combined with decriminalization efforts, the R3 program is the first attempt of a state to offer reparations to the victims of marijuana criminalization. However, the success of such programs inherently depends on tax revenue and therefore relies on a growing market, calling for a deeper understanding on how to tax marijuana. Because of the lack of research and literature in the field, it is close to impossible for states to write effective marijuana tax policy. The likelihood of more states legalizing cannabis, and the constant push for federal legalization, motivates this research.

A thorough literature review will explain how this paper contributes to the existing, but scarce, economic literature. A summary of the history of criminalization of cannabis in the U.S., will also explain why reparations are being included in new policies. Questions regarding tax incidence, complements and substitutes, and other market parameters are answered through the creation of a new data set, which combines cannabis and non-cannabis variables. The independence of each state also calls for a cross-state approach. The results from Colorado, a more mature market, will be used to evaluate Illinois newborn cannabis market and the state's plan to utilize cannabis tax revenue to fund reparations. This evaluation, combined with

qualitative observations from interviews of dispensary owners in Chicago, IL, will shed light on the many questions that still surround the topic of taxation of legal cannabis and its potential role in advancing racial-economic equality in the U.S.

Before describing the contributions and limitations of the field of economics in studying cannabis and its policy, I want to acknowledge the different ways this paper is paving the way for future research. This thesis represents the first attempt in economic literature to understand the cannabis market and its potential in funding reparations simultaneously.

## **II. Literature Review**

Academic research on the subject of cannabis has always been limited by marijuana being classified as a Schedule I drug. Literature in the field of economics is no exception and can be divided into two phases: pre and post state legalization. Legalization impacted economic research profoundly, allowing researchers to disregard approximative survey data on small sample sizes, and embrace real market data. Still, because of this division, it is crucial to consider both historical periods to comprehensively describe the economic literature on marijuana.

In the '90s, cannabis became a subject of interest in the field of economics. The topic of cannabis is vast, but pre and post legalization studies mainly focus on customers' use of cannabis and on estimating the size of the legal and unregulated markets (Matthias Parey, 2017; Jan C. van Ours, 2007). While both topics can increase our knowledge of the market, this research focuses on the taxation of cannabis, barely mentioned in studies on market sizing and marijuana use.

Dale Gieringer, in 1994, writes one of the first studies addressing cannabis taxation, evaluating potential tax types, including a "harmfulness tax." Even if his analysis is applied only to joints rather than loose cannabis, which do not represent a reliable unit of measurement, he

still recognizes cannabis' potential to "save taxpayers around \$8 - \$16 billion, not counting the economic benefits of hemp agriculture and other spinoff industries" (Gieringer, 1994). The lack of market data, together with the limitations of the unit of measurement used, make this result unreliable. Still, Geiringer's paper represents a steppingstone for the field, and it paved the way for other estimations. Just a few months later, another study estimates the size of potential tax revenue from the legalization of marijuana to range from \$2.55 to \$9.09 billion. The study, published in *The American Journal of Economics and Sociology*, is first at acknowledging "the uncertainty surrounding the price elasticity of marijuana", also a central topic of this research (Michael R. Caputo, 1994).

Another aspect covered by pre-legalization literature is possible economic substitutes and complements of cannabis. Most, if not all, literature looks at the relationships of alcohol and tobacco with cannabis; however, with mixed results. Looking at three studies spanning from 1997 and 2004, some describe alcohol and tobacco as complements and others as substitutes (Frank J Chaloupka, 1997; Pacula, 1998; J. Williams, 2004). The main limitation of all of these studies is the lack of a regulated cannabis market to access data from. All pre-legalization studies on substitutes and complements rely on survey data with small population sizes. Because of the lack of contemporary research analyzing this topic, this research will use Colorado's data to understand whether alcohol and tobacco are economic substitutes or complements.

In post-legalization studies, interest shifts to taxation. This includes the limitations of a cash-only market on tax collection, the effect of taxes on cross-state import and export of cannabis, and potential supply-side costs due to tax management (Nima H. Mohebbi, 2015; Jonathan P. Caulkins, 2012; Arrowsmith, 2017; Teresa L Elliott, 2019). While these studies are useful to frame cannabis taxation and the cannabis market, they differ from this research. In fact,



mainly due to the scarcity of data, only two post-legalization studies try to understand the incidence of tax changes in the cannabis market. The first, published in 2017, “The Taxation of Recreational Marijuana: Evidence from Washington State,” like this paper, looks at the effects of a single change in marijuana taxes on the market (Benjamin Hansen, 2017). The study is able to determine that demand for marijuana is price-inelastic in the short-run but becomes price-elastic in weeks after the tax change. However, because this tax change includes both an increase in rate and a change in tax type<sup>6</sup>, the result cannot be compared with this analysis of a single change in Colorado’s tax rate. Still, this result is first in evaluating economic parameters of the cannabis market at a state level, and it paved the way for future calculations.

Published two years later, “Marijuana tax incidence, stockpiling, and cross-border substitution” also uses a 25 percent tax increase as a natural experiment to measure its effect on price, quantity, consumer stockpiling, and cross-border purchasing in Oregon (Muhammad Salar Khan, 2019). This research also calculates the price elasticity of cannabis demand, determining it to be negative and inelastic ( $-0.467$ ). While it would not be sound to apply results from Oregon to Colorado’s cannabis market, the 2019 study informs this research in its experiment methodology: utilizing one tax change to determine market responses. Other methodologies in the field of public finance and public policy have been consulted, however, with little success. Even if several studies are available, most look at markets older than cannabis’ (tobacco, gasoline, and soda) and do not account for a sole tax change to calculate market incidence (John Cawley, 2016; Badi H. Baltagi, 2004; Nikolay Gospodinov, 2009).

It is also important to note some of the differences between this research and the Oregon study. As it will also be discussed in the Data section of this paper, the data collected from

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<sup>6</sup> Washington State switched from a 25 percent gross receipts tax collected at every step in the supply chain to a sole 37 percent excise tax at retail (Benjamin Hansen, 2017).

Colorado spanned from 2014 to 2020 with a monthly frequency, while Oregon's only covered from October 2015 to March 2016, with a daily frequency. Analyzing a longer time frame, this research looks at a more developed market than the Oregon paper, possibly leading to more accurate results. Another difference between the two studies is that Oregon's research only accounts for cannabis-related control variables in its dataset. This approach can potentially lead to supply and demand factors to be omitted when running linear regressions on the dataset; therefore, this paper is the first cannabis study to include both cannabis and non-cannabis variables to determine the market incidence of a tax change.

This research is breaking ground in the context of data analysis, but also in combining economic research with policy. No previous econometric research on cannabis attempts to utilize a data approach to inform policy on reparations. Because of this research focus, it is crucial to also outline the history of marijuana criminalization to explain current policy attempts to include social-equity programs. Three books allowed this paper to summarize the long history of cannabis in North America: "Smoke Signals" by Martin A. Lee, "Weed the People", by Bruce Barcott and "Cannabis: a History" by Martin Booth (Booth, 2003; Barcott, 2015; Lee, 2012). These sources track all the policies that have impacted cannabis and its users, leading through the criminalization into the era of legalization. To supplement the information from these books, original reports and documents were accessed. For example, the "Marijuana: A Signal of Misunderstanding," also known as the Shafer Report (1972), allowed for a better understanding of the change in the perception of cannabis through the '70s (Raymond P. Shafer, 1972). To collect updated information on current legalization policies, Colorado and Illinois government websites, together with several reliable news sources, have been utilized to paint a comprehensive picture of today's U.S. cannabis market.

Some of these sources do mention the damage brought by cannabis criminalization and mass incarceration; however, few connect the idea of cannabis revenue to reparation. Khadijah Tribble champions this idea in “Reckoning with Reparations: The Kush Economy is Our 40 Acres and a Mule” (Tribble, 2018). This academic paper traces the “collateral consequences [of the War on Drugs] that perpetuate an unrelenting cycle of poverty” in African American communities, advocating for cannabis tax revenue to fund reparations programs. In order to describe and quantify the impact described by Tribble, this research uses data collected by the American Civil Liberties Union in a report called “The War on Marijuana” (American Civil Liberties Union, 2013).

Academic literature on the effects of the War on Drugs and mass incarceration is prolific; still, no economic studies estimate the total monetary need for reparations in the U.S. The lack of a figure quantifying the damage of the War on Drugs limits how research can evaluate reparations. Regardless of these limitations, a diverse set of sources, including academic research, reports, books, news, and in-person interviews with dispensary experts in Illinois, allowed for this research to come to life. Through a comprehensive history of cannabis, and the analysis of the Colorado and Illinois cannabis markets, this paper tries to push the research scope of post-legalization studies to include policy.

### **III. History of Cannabis in the United States**

The two markets analyzed in this research, Colorado and Illinois, differ in many ways, including size, age, and, particularly, policy. When looking at arrest rates for marijuana possession between 2000 and 2010, it becomes clear why policies differ. In Illinois, African Americans were 7.6 times more likely to be arrested for marijuana possession than whites, a

much higher rate than in Colorado. The racial disparity in arrests, together with high rates of incarceration, led African American communities in states like Illinois to suffer the economic and social impact of marijuana criminalization and mass incarceration (American Civil Liberties Union, 2013). Because of this impact, when Illinois legalized recreational cannabis in 2020, it was decided that 25 percent of cannabis tax revenue would be dedicated to funding reparations for these communities. This section will illustrate that the necessity to use cannabis as a tool of reparations is not constrained to Illinois or to the 2000s. The war on cannabis is a country wide reality that has intensified and spread since the beginning of the twentieth century. Therefore, before discussing the details of reparation programs in Illinois, it is crucial that the reader is familiar with the history of criminalization of cannabis in America. This history will inform the need for cannabis policy to focus on social equity and lay the basis for an analysis of Illinois' marijuana market.

### **Early History: 1900-1920**

Cannabis grew naturally in North America during the beginning of the twentieth century. In Mexico, cannabis was used as part of religious rituals, and Mexicans referred to it as *rose maria* or sacred rose. The botanical flexibility of the plant allowed it to grow wild and adapt to different climates, soils, and altitudes. Cannabis was so easily obtainable in nature that even during the Mexican Revolution (1910 -1920), Pancho Villa's troops smoked the plant during long marches to celebrate victories (Lee, 2012). Accounts narrate that even American troops, led by General John Pershing during the Mexican Expedition against Villa (1916), took on the habit of smoking cannabis mixed with tobacco. The habit of smoking did not remain constrained to south of the U.S. border for long. When hundreds of thousands of Mexicans found refuge in the U.S. as a result of the Mexican Revolution, American border cities started seeing the first signs

of cannabis consumption (Barcott, 2015). Some of these cities reacted quickly, like El Paso, TX and proceeded to prohibit the use and commercialization of cannabis in 1914 as a result of the rising consumption from the recent refugees. This appears to be the first example of cannabis regulation being used as a tool of discrimination, a trend that would continue for the entirety of the twentieth century.

Cannabis wasn't included in the Harrison Act (1914), which put narcotics such as cocaine under federal control, but many states still banned the substance (Barcott, 2015). California is the first example of this trend. After banning opium and queues (a typical Chinese hairstyle) to discriminate against Chinese migrants, the Golden State was the first state to make cannabis illegal. This time the regulation had the goal of harassing the rising number of Mexican immigrants, known for being the first cannabis smokers in the U.S. (Booth, 2003). Cannabis, even if still legal at the federal level, with limitations only in individual states, still had to survive the American twenties, a decade that marked the beginning of prohibition, the Ku Klux Klan, and other white supremacist groups that started targeting blacks, Mexicans and other minorities considered "un-American" (Lee, 2012).

### **1920s-1930s**

The use of cannabis as a discriminatory political tool led to the formation of numerous misconceptions around the plant, as well as the inclination to refute any positive findings on the plant's properties. For example, in 1925 American soldiers based in the Panama Canal were found habitually smoking cannabis. This awakened the interest of the military, which established a formal committee to find potential adverse effects of the plant on the human body. The committee concluded in the first ever American study of cannabis, that the substance was non-addictive and did not have "any appreciable deleterious influence on the individual using it"

(Lee, 2012). These results were ignored by the American government, which passed in 1929 the Narcotic Farms Act, classifying cannabis as an addictive drug and announcing the creation of two hospitals to cure cannabis addiction. Despite the release of the first American study on cannabis, anti-marijuana propaganda continued expanding across the U.S. This would not be the only time that the American government disregards research findings to advance the anti-cannabis discourse.

This time period also saw cannabis becoming increasingly popular. In fact, prohibition and the Great Depression forced people to search for cheaper alternatives to alcohol. This brought cannabis in the mainstream. Even if socio-economic and cultural factors brought cannabis to people from all races and ethnicities, it wouldn't be long until the government would start associating it with African American communities.

In 1930, an infamous figure took control of the newly formed Federal Bureau of Narcotics (F.B.N.) for over thirty years: Harry Jacob Anslinger. Anslinger's initial focus as the head of F.B.N. was alcohol, not cannabis. Things changed in 1934 when tax revenue, as a consequence of the Great Depression, reached a low, putting in jeopardy Anslinger's position and his department. He had to prove the necessity of an anti-drug department and saw in cannabis the perfect way to do so. In just a few years, a man who barely cared about cannabis and its role in American society became the number one opposer of the plant. The head of the F.B.N. soon tried to establish a link between cannabis and crime, attempting to legitimize the war he was about to start against pot and its smokers. Anslinger was not carrying out this battle alone. With strong alliances in the press, one of which was William Randolph Hearst, the owner of the most extensive communication and media empire in America called Hearst Communications, Anslinger started not only a legal battle against marijuana but also a brutal media campaign. Ads,

fake news, and movies such as *Reefer Madness* described cannabis as crime-inducing substance, a gate-way drug, and as a lubricant for interracial relations. These false depictions of cannabis users lured the public into becoming anti-marijuana advocates, creating stereotypes that remain alive to this day<sup>7</sup>. It wouldn't take long for propaganda to spill into reality. After claiming in 1936 that marijuana was the "cause" for 50 percent of the violent crimes among districts occupied by minorities, Anslinger and Hearst pushed for the deportation of over two million Mexicans. After turning cannabis into a legal weapon against minorities, Anslinger started working on adding more barriers to suffocate the cannabis trend. The U.S. government introduced the *Marihuana Tax Act* in April 1937, placing a tax high enough to make the substance inaccessible to most across the States. The tax impacted hundreds of thousands of Americans, who consumed cannabis either recreationally or in pain medication (Lee, 2012).

#### **1940s – 1960s**

Regardless of the new regulation, Anslinger struggled to control a plant that could be grown everywhere and that was being smoked now by a hundred thousand Americans (Lee, 2012). This would be just the start of the challenges faced by Anslinger. First, with the United States entering World War Two, hemp production was incentivized by the government to support the country's war efforts, putting brakes on cannabis control. Second, Anslinger and the U.S. government had to respond to the results of further research on cannabis. The LaGuardia report, published in 1944 and commissioned to the New York Academy of Medicine, dismantled many of the misconceptions promulgated by the government and the media. The report not only proved that the correlation between cannabis and crime was a myth, but it also demystified the

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<sup>7</sup> In order to associate cannabis with Mexicans, Anslinger started using the Spanish word for the plant: marijuana (Barcott, 2015).

idea that weed was a gateway drug to heroin. Anslinger and the F.B.N., after associating cannabis with crime, interracial sensuality, and heroin, were left fighting a government-commissioned report that portrayed cannabis as a "mild euphoriant" (Brooks, 2016)

Anslinger had to change his rhetoric in order to keep advancing his anti-cannabis agenda. In the early years of the Cold War, drugs such as cannabis started being depicted as threats to national security. Consequently, the additional policy was put forward to regulate marijuana even further. The Boggs Act revoked any distinction between traffickers, dealers, and users, streamlining the conviction process. President Eisenhower intensified anti-marijuana efforts in 1956 by passing the Narcotics Control Act, which increased the punishment for drug related crimes (Lee, 2012).

In the 1960s Anslinger continued his efforts to putting a stop to the "marijuana epidemic." However, he was not the only one with a mission. The Sixties saw younger generations fighting to demolish racial barriers across American legislation. The Civil Rights Movement spread across college campuses, where cannabis was already becoming more popular. Marijuana became a constant presence in organized protests, to the point of turning into a symbol of peaceful protests. However, this increase in popularity, and the association with the Civil Rights Movement, turned cannabis into an even larger target and an even more dangerous weapon. When asked about this time, John Ehrlichman, Nixon's former domestic policy advisor, said:

"The Nixon campaign in 1968, and the Nixon White House after that, had two enemies: the antiwar left and black people. You understand what I'm saying? We knew we couldn't make it illegal to be either against the war or black, but by

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<sup>8</sup> The sixties also saw the birth of the movement for marijuana legalization (Lee, 2012).



getting the public to associate the hippies with marijuana and blacks with heroin, and then criminalizing both heavily, we could disrupt those communities. We could arrest their leaders, raid their homes, break up their meetings, and vilify them night after night on the evening news. Did we know we were lying about the drugs? Of course we did" (Tribble, 2018).

While cannabis was used to target minorities throughout American history, the sixties marked the beginning of systematic, racial, and cross-generational oppression through the criminalization of cannabis. Even if this decade will always be remembered for ending Jim Crow laws, it was also instrumental in building the basis for the era of mass incarceration, later called by Michelle Alexander, civil rights lawyer and scholar, "The New Jim Crow" (Alexander, 2010).

### **The War on Drugs: 1970s – Present**

In 1970, Nixon, with the help of the attorney general John Mitchell, ratified the Controlled Substances Act, placing marijuana together with L.S.D. and heroin as a Schedule I drug<sup>9</sup>. Substances in this category are deemed highly addictive and with no therapeutic or medical use. Other than perpetuating false information, Nixon successfully weaponized the most commonly used drugs by minorities. Cannabis and other drugs became a way for the government to oppress minorities similarly - but at a larger scale - mirroring what happened before the Civil Rights Movement. While Nixon doubled down on the "marijuana problem," he did so both by enabling the police and trying to spread misinformation about the plant.

In the Seventies, Nixon created a commission, led by former Pennsylvania governor Raymond Shafer and other hardcore republicans, to thoroughly research the effects of cannabis

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<sup>9</sup> In the meantime, cocaine, often used in the Wall Street circles, was placed in Schedule II together with substances with acceptable medical use, protecting the wealthiest societal group from the consequences that come from abusing substances (Lee, 2012).

on its users. When the report was published with the title "Marihuana: A Signal of Misunderstanding," (1972) it went against everything that Nixon had hoped for. The commission not only calculated that more than twenty-four million Americans had tried the drug but also established that the substance posed little to no risk for its users. The Shafer report makes critical remarks, such as that marijuana use spreads across social classes and geographical regions, and it compares the effects of the plant to the damaging effects of alcohol and tobacco. Lastly, it states that cannabis smokers are "indistinguishable from their non-marijuana using peers by any fundamental criterion other than marijuana use," dismantling stereotypes and misinformation regarding the "devil's lettuce." Not advancing Nixon's anti-marijuana agenda, the report would be ignored by Nixon, who intensified his efforts in the War on Drugs.

After Nixon's disastrous end to his presidency<sup>10</sup>, President Ronald Reagan would have a much more profound impact on the plant and its users. At the beginning of his mandate, President Reagan increased anti-drug spending to \$196 million from \$1 million in five years and re-allocated the budget to enable surveillance and punishment operations while also cutting drug treatment programs (Barcott, 2015). Reagan not only heightened the "war" aspect in the war against drugs, but he was also able to pass his mission on as the 1990s started. From 1990 to 2002, the overall arrest rate in the United States dropped by 3 percent; however, the rate of arrests for marijuana-related crimes rose by 113 percent. These statistics depict an unbalance that will extend through contemporary days. Between 2001 and 2010, there were more than 8 million marijuana arrests, of which 7.29 million were for possession only. Through the decade this worsened, with 2010 reporting an 18 percent increase in arrests for possession since 2001. These

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<sup>10</sup> President Ford continued what was started by his predecessor, even if cannabis had found its way even within the American ranks during the Vietnam war. His successor, President Carter, had minimal impact on policy regarding cannabis usage for recreational and medical use.

aggressive arrest rates consequently led to a higher incarceration rate and to the problem of mass incarceration. To put this issue in perspective, consider that the U.S. during the 2000s accounted for 5 percent of the world's total population, but it had 25 percent of the world's prison population.

Mass incarceration did not impact society evenly, in fact the African American community was affected disproportionately. When looking at the increase of marijuana arrests and keeping in mind that cannabis consumption rates are very similar across different races, African Americans still comprised the majority of these arrests. In 2010, at a national level, African Americans were 3.73 times more likely to be arrested for marijuana possession. This is a national figure, and when looking at regional data or even county data, these numbers become even more staggering. Looking at the micro level, in 96.1 percent of counties across the country African Americans were more likely than whites to be arrested for Marijuana related crimes. Rates differed based on the geographical area, with the Northeast and the Midwest leading this inequality in arrests. When looking at key states analyzed in this research, Colorado had one of the lower rates of racial disparity in arrests in the country. Here still, African Americans were 1.9 times more likely to be arrested for marijuana possession than whites. This figure skyrockets when looking at the other state analyzed in this research, Illinois. Illinois has one of the worst track records in the country; African Americans were 7.6 times more likely to be arrested for marijuana possession. In the same year, 2010, the state spent over \$221 million on the enforcement of marijuana possession laws (American Civil Liberties Union, 2013).

In order to understand the problem of the War on Drugs, we cannot see the increase of marijuana arrests and incredibly high racial disparity rates in arrests across the country as two separate issues. The staggering number of people arrested for marijuana led to the problem of

mass incarceration, and the racial disparity in arrests led mass incarceration to become a black problem. This history of criminalization deeply impacted the African American community. When a large portion of a community spends some time in prison, the effects reverberate in all aspects of life: education, employment, housing, family and intimate relationships, and economic wealth (Kim M.Blankenship, 2018). In other words, mass imprisonment damages social networks, social norms, and destroys social citizenship. We need to remember that mass incarceration overwhelms not only the individual, but also their family and the larger community, making it harder to form expansive networks that are most adept at producing social capital (Roberts, 2004). When looking at the effects of mass incarceration, we cannot forget that all of these issues ultimately impact the pockets of citizens and their ability to build generational wealth. Mass incarceration has directly and significantly increased poverty, regardless of which index is used to gauge poverty, leaving a permanent mark on many communities (Robert DeFina, 2009).

Mass incarceration had, and still has, a generational impact on African American communities. Even in 2018, with eleven states having legalized cannabis, the number of marijuana arrests increased to 663,367, “that's one every 48 seconds, and represents an uptick from the 659,700 cannabis busts American police made in 2017, and from 2016's total of 653,249” (Angell, 2019). These numbers highlight how the problem of marijuana incarceration, even if not at the levels of 2010, continues today, regardless of the legalization movement.

This long history of criminalization, and the impact of racialized mass incarceration, emphasize the essential factor to consider when discussing the future of marijuana policy: equity. Cannabis and race have often, if not always, meant the same thing through the history of cannabis criminalization. Therefore, it is not possible to talk about marijuana legalization without

including the idea of reparations for the War on Drugs. This research needed to acknowledge the history of cannabis in the United States. While a data approach is needed to define the future of marijuana policy, without understanding the history of oppression that has surrounded cannabis, and without an attempt at repairing the damages made by marijuana criminalization, we cannot say to have found a fair way to regulate the legal cannabis market. Therefore, this research will adopt a data approach to both understand how this new product behaves in Colorado, and to understand how the results can inform equity focused policy. For this reason, the Illinois market will also be analyzed, is the first state to introduce a comprehensive plan to repair the damage of the War on Drugs on marginalized communities.

#### **IV. Data Analysis: Colorado**

##### **Sourcing and Gathering Data**

Answering analytical questions about the American legal cannabis market can be a challenging task. Because each state has a high degree of autonomy in writing cannabis regulation, it also represents a different case scenario with different conditioning variables. This diversity makes it impossible to combine data from different states, or even to access it. As of today, very few U.S. states make their cannabis data available to researchers and third parties. Colorado, being one of the first states to legalize cannabis and one of the few to make its data available, offers information spanning six years and it was selected as the primary data source. Another state considered was Nevada. One of the few to release its data, it only began recreational sales in 2017, too recently to provide a meaningful data set; therefore, it was disregarded (Stinnesbeck, 2018). Ultimately, Colorado was the only state in the U.S. with accessible data and a long enough history (since 2014) to conduct econometric research on (MED, 2020). This should be noted for future research: as more states make their data available,

it will permit cross-state analysis. Once the focus was narrowed to one state, it was crucial to think both of cannabis and non-cannabis related variables to describe and analyze the market. In order to learn more about the legal cannabis market in Colorado and understand how the market responds to changes in tax rates, a wide range of variables and data sources needed to be considered.

Starting with cannabis related data, this research looked at data indicative of market performance and supply and demand factors, including price, cultivators and distributors. Colorado makes its cannabis data available through government entities, which ensures its reliability and public access. All the cannabis data was collected from one source: Marijuana Enforcement Division (MED), a subsection of Colorado's Department of Revenue.

MED's reports offer a wide range of data points: total sales, recreational sales, medical sales, and a complete breakdown of tax revenue both by cannabis type (medical and recreational) and tax type. All of this data is available with a monthly frequency, and it has been collected by accessing each monthly report available from January 2014 to November 2019. Having data available for both recreational and medical sales is crucial to single out the effects of tax changes. In fact, another way to look at recreational and medical data is to consider the former as a taxed market and the latter as untaxed, since current policy does not place tax burdens on the medical market other than the 2.9 percent state sales tax applied to most goods (Colorado Legislative Council, 2020). Having separate data on the taxed market (the recreational market), allows me to conduct a more precise econometric experiment on tax elasticities. Furthermore, because there was only one tax rate change through Colorado's history of legalization, and it took place only on the Retail Marijuana Sales Tax, obtaining data on each market and tax type increased the accuracy of this analysis.

Other variables collected from Colorado's government website are information on median market prices for cannabis, the numbers of medical and recreation dispensaries, and the number of medical and recreational cannabis cultivators. While this data is from the same source, it presented some complications. First of all, median cannabis prices are not available at a monthly frequency. Pricing data is reported biannually between 2014 and 2016, and quarterly for 2017, 2018, and 2019. The lack of monthly frequency posed barriers to the econometric analysis. However, data on numbers of dispensaries and growers is published monthly, and because of its consistent coverage between 2014 and 2019, it can be used in conjunction with sales and tax revenue data. While this data is consistently available for the appropriate time range and with monthly frequency, the data gathering process posed some challenges. All the data discussed so far is available in digital format, which promoted a consistent and precise data gathering process. However, data on numbers of dispensaries and growers between 2014 and 2016 was not available in a format that could be imported into excel. This required that all the data for said time frame, comprising a total of 96 monthly reports, to be printed, and counted manually, to be recorded in digital format along the rest of the data set. This process required counting all the thousands of retail and cultivations licenses issued by the state of Colorado between 2014 and 2016. The process, being manual, is not error free, and even after being double-checked by multiple counters, it begs for consideration when evaluating the validity of the data set. In addition to possible transcription errors, some monthly reports were missing, and caused the data set to have 4 missing data points for recreational cultivations and 7 for medical cultivations. Even if the lack of some data points does not pose too much risk for statistical analysis, it does raise some questions regarding the reliability of the data reported by MED and the government of Colorado.

In order to take account of population growth, the employment cycle, seasonality, possible substitutes and cost of transportation - one of the main supply-side costs in the market - additional data was included in the analysis. This additional data brought several conditioning variables in the data set to capture supply and demand-related factors that determine equilibrium quantity and the price of cannabis. Data on new housing listings, together with relative median market prices, and retail grocery store sales in Colorado were added to the data set to account for income and number of demanders.

The first, sourced from the Colorado Association of Realtors, covers the same time frame as cannabis sales data with monthly frequency (The Colorado Association of Realtors, 2020). Data on retail grocery sales, while also reported monthly, only covers between 2015 and 2019 and it is also sourced from Colorado's Department of Revenue website (Revenue, 2020). Consumer price indexes, sourced from the U.S. Bureau of Labor Statistics (BLS), for potential cannabis substitutes - tobacco and alcohol products - were added to the dataset (FRED Economic Data, 2020). To take into account the business cycle, seasonally adjusted state unemployment data for was also added to the data set from the BLS (U.S. Bureau of Labor Statistics, 2020). Lastly, PPI for truck transportation of freight was added to take into account one of the main supply costs of the cannabis market (U.S. Bureau of Labor Statistics). All non-cannabis data covers the desired timeframe with a monthly frequency.

This approach allowed me to build an extensive data set to analyze and evaluate the Colorado market for cannabis while taking into account general market dynamics. This dataset represents a first of its kind, as no economic research in the field of cannabis has analyzed the market contextualizing with other market parameters. Before jumping into the econometric



analysis of the data set, in order to understand how taxation works in the market, there are number of observations about the cannabis market that can be derived from the data collected.

### The Colorado Market

Medical marijuana has been legal in Colorado since 2000. In 2012, 55 percent of voters approved Amendment 64, making Colorado the first U.S. state to legalize recreational marijuana, which became effective as of 2014 (McCoppin, 2019). This research’s data set also begins in January 2014, which enables us to compare how the recreational and medical market developed when both were present. Before comparing how the markets performed it is important to note some qualitative differences between the markets. The medical market in Colorado is off limits to all marijuana users without a medical recommendation and a medical card. All the weed sold for medical purposes needs to come from medical cultivations, which operate under different, and stricter, regulations. Instead, recreational sales are open to anyone over 21 years of age, but also have some limitations on how much a consumer can buy and much they can possess at one given time. Because of different regulations, the recreational market poses fewer barriers for both customers and suppliers, which do not need to abide by medical regulations.

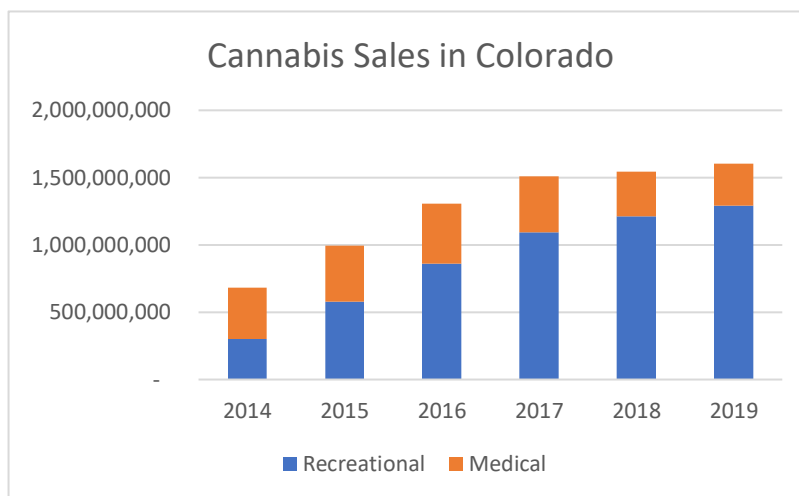


Figure 1

These differences explain how differently the two markets developed. Looking at total sales in 2014, the medical market outperformed the novel recreational market (Figure 1). Still, the 44 percent market share of the recreational market is still sizable for a one-year old market . Testifying to its disruptive effects, in only one year of activity the recreational market surpassed the older medical market. During 2015, the market share of recreational cannabis jumped to 58 percent. Market share has kept growing up to the present, with 2019<sup>11</sup> data reporting a market share of 80.6 percent for recreational marijuana. Ultimately, the recreational market comprises most of the marijuana sales in Colorado. However, this is not only due to faster growth of the recreational market. Looking at the performance of each market individually, it can be noted that the medical market has been in slight decline since 2014.

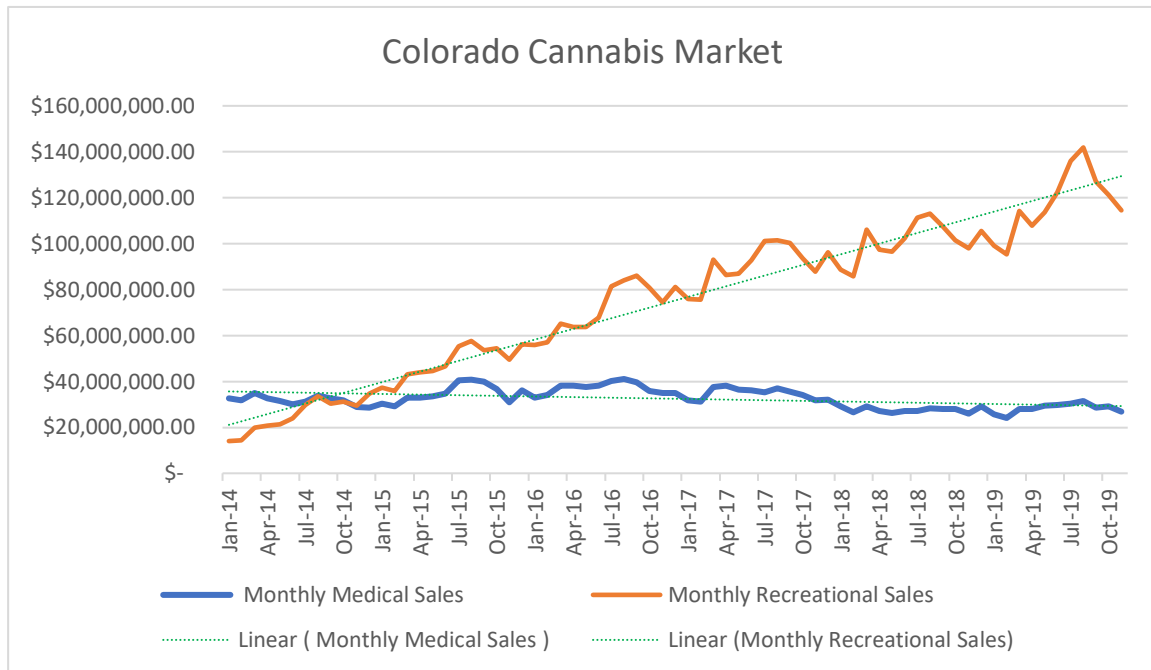


Figure 2

<sup>11</sup> Monthly sales December 2019 have not released at the time of this research

Between 2014 and 2019, the medical market has been mostly stagnant with a downward trend (-0.02%) (Figure 2). The recreational market, on the other hand, has been growing at a steady pace. Looking at the two sub-markets' monthly performance it is also clear that the recreational market sees more intense fluctuations. Notably, April represents a seasonal spike, probably correlated to the poplar tradition of "4/20". Another month that sees higher sales growth rates is July, maybe connected to the summertime and students' finishing the school year. These seasonal fluctuations will be taken into account in the econometric analysis using monthly dummies.

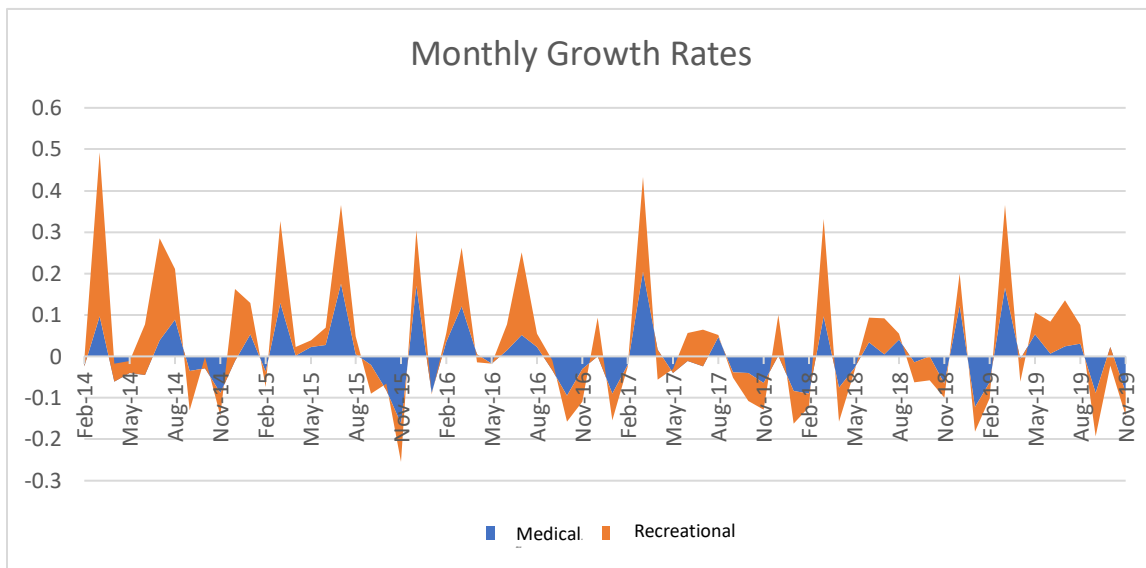


Figure 3

A graph staking monthly growth rates in the two markets, allows for consideration of tax changes. Recreational cannabis, before August 2017, was subject to a 2.9% State Sales Tax, a 10% Retail Marijuana Tax, and a 15% Excise Tax. Effective August 2017, the Retail Marijuana Tax, levied only on the recreational market, was increased from 10% of total sales to 15%. Other taxes on recreational cannabis, as well as taxation for the medical market, remain unchanged

(Colorado Legislative Council, 2020). Nothing in the graphic representation of recreational and medical sales hints at a change in market performance due to the tax increase. When looking at growth rates of the two markets for August 2017, interestingly the untaxed medical market, experiences a growth rate of 4.7% while recreational sales only of 0.5%. During the year leading up to the tax change, the recreational market grew by 3.16%, much higher than when the tax change occurred. Monthly growth rates can also be observed in Figure 3. While this discrepancy could be explained by customers churning from the recreational market due to the tax change, ultimately a regression analysis will shed more light on the effect of the tax change on market growth.

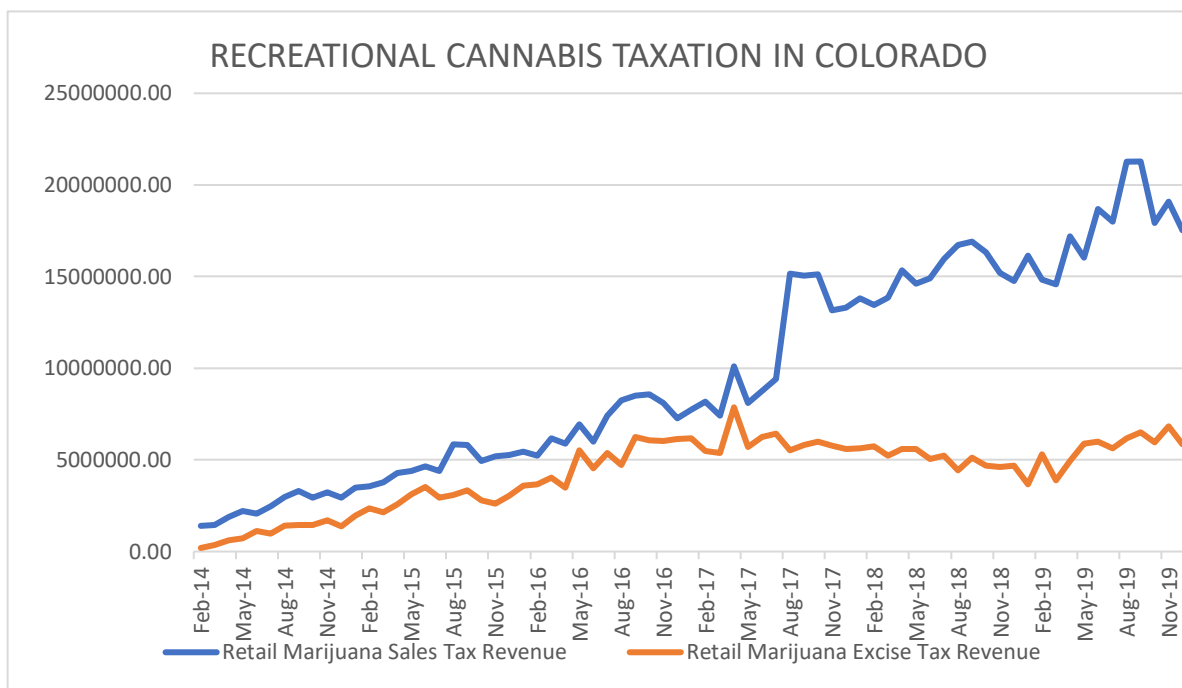


Figure 4

Looking at a graphical representation of the Marijuana Sales Tax revenue and the Marijuana Excise Tax (unchanged), the impact of the tax change becomes evident. The change of August 2017 made the two tax revenues diverge and allowed the marijuana sales tax to become the primary source of revenue for the government in the cannabis market (Figure 4).

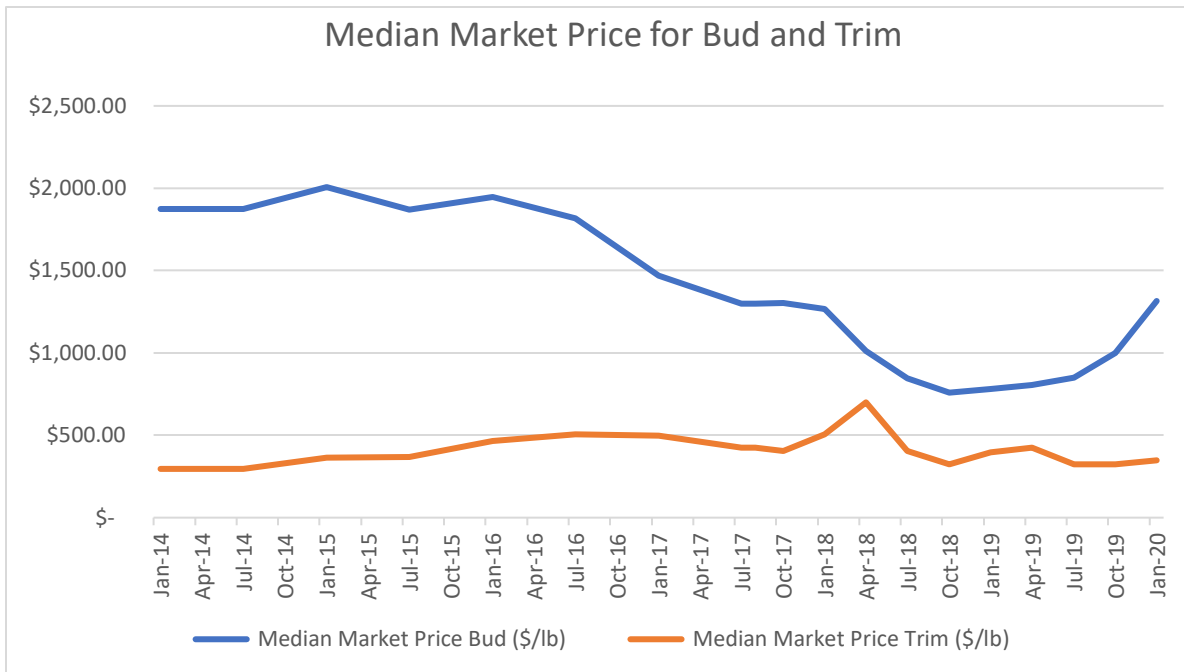


Figure 5

Before looking at the results of the regression analysis on the Colorado market, it is important to discuss the pricing of the product. As illustrated in Figure 5, there are two main products that can be derived from the Marijuana plant: bud and trim. Bud is the flower produced by the female cannabis plant, and it is the natural product with the most cannabinoids and terpenes, and therefore more expensive. Trim, instead, is a result of the grinding of the bud, leaves, and other parts of the cannabis plant. The more “diluted” product is often used as a filler to prepare pre-rolled joints. The price for trim is not particularly interesting for this research since it’s rarely used as benchmark for different state markets. However, the price of bud becomes crucial when comparing results from Colorado with other states. Cannabis prices started high in Colorado, possibly due to supply side costs. Because the market in Colorado is an unlimited license market, with no government caps on how many can grow and how much they can grow, cultivators were able to reach economies of scale and start producing cheaper bud.

When looking at other states, this is often not the case. Recreational bud prices reached the \$85 mark for 3.5g<sup>12</sup> of product in IL, while in Colorado they have been steady at around \$35 during the last two years (Fix, 2020). Pricing is crucial to consider because the main competitor of the legal cannabis market is still the unregulated market, which attracts customers by offering much cheaper product and with no additional taxes. A final consideration when looking at Figure 5 is the latest upward trend in median market price for bud. When looking at the legal cannabis market both in Colorado and throughout the entire country, marketing has been emphasizing premium quality of the product. Highlighting whether the flower is organic, indoor or outdoor grown, or used by a 420 celebrity, marketers have started branding cannabis as a luxury product. This factor, among other questions about the cannabis market in Colorado, will be addressed by the regression analysis.

### **Regression Analysis**

In order to reach significant results, two different sets of regressions have been run on two different versions of the data set. The first, was run on the data converted to millions. The second, was run on monthly changes of each variable, in order to correct for the common time trend across variables. These two sets looks at the same three different dependent variables: monthly recreational sales, the monthly sales spread between the recreational and medical market, and the revenue from the Marijuana Sales Tax.

The goal of this analysis is to understand the incidence of the tax change on the recreational market. Observing how cannabis is being branded throughout the United States, mainly as a premium product, I do not expect demand to be particularly sensitive to price or tax changes. Customers who decide to travel to a dispensary to buy legal and premium quality

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<sup>12</sup> Standard measure of product, also 1/8<sup>th</sup> of an ounce.

recreational weed probably aren't as price sensitive as users who decide to procure the herb from the unregulated market. At the same time, it is important to remember that Colorado's market is fairly mature now, and features some of the lowest prices in the nation for legal marijuana. Being used to pay fair prices, unlike Illinois customers, Colorado customers might have become more price sensitive over time. Therefore, results could lean either way.

Another aspect to consider is the spread between recreational and medical sales. I believe any effect of the tax change will be larger on the spread than on recreational sales. Possibly, depending on barriers to entry, tax increases on the recreational market could push customers to obtain a medical license and switch to the medical market. Any decrease in recreational sales due to the tax increase, could be compensated by some increase in medical sales. Therefore, looking at the spread between markets could be a more accurate way of interpreting tax incidence on the market. Looking at the effect of the tax change on Marijuana Tax revenue, results strongly depend on where the market is situated on the Laffer curve. Is a 5 percent tax increase large enough to deter enough customers from the market to decrease tax revenue? If the hypothesis about legal weed customers not being price sensitive is true, then the answer should be no.

Lastly, an aspect that is central to this research is establishing whether alcohol and tobacco are economic substitutes or complements for cannabis. Because alcohol impairs judgement and changes behavior more than tobacco, I expect it to be a substitute of marijuana. Tobacco constitutes a more intricate question. In regions like Europe, tobacco is often mixed with weed to be used as a filler in joints. This behavior could lead tobacco to be a complement of marijuana, but it highly depends on regional trends and preferences<sup>13</sup>.

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<sup>13</sup> There are not studies looking at habits such as mixing tobacco for the U.S., therefore it is hard to make a prediction. However, if also American weed smokers use tobacco as a filler, it could have easily become an economic complement of cannabis.

<b>TABLE 1</b>	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	Monthly Recreational Sales	Monthly Recreational Sales	Monthly Sales Spread	Monthly Sales Spread	Marijuana Sales Tax Revenue	Marijuana Sales Tax Revenue
Date	0.242 (0.774)	0.736* (0.425)	0.401 (0.734)	0.656* (0.378)	0.138 (0.156)	0.104 (0.0972)
Tax Change Dummy	2.900 (3.265)	2.863 (2.938)	4.661 (3.257)	4.268 (2.775)	4.873*** (0.587)	4.697*** (0.526)
Grocery Sales	0.00377** (0.00146)		0.00397*** (0.00143)		-0.000724** (0.000280)	-0.000891*** (0.000319)
Sold Listings (Single Family)	0.00298*** (0.000537)	0.00292*** (0.000459)	0.00184*** (0.000468)	0.00175*** (0.000415)	0.000240*** (7.84e-05)	0.000231*** (7.90e-05)
CPI Tobacco	-0.0632 (0.0952)		-0.0950 (0.0977)		-0.00803 (0.0184)	
PPI Transportation	-0.583 (1.090)	-1.973*** (0.606)	0.730 (0.937)	-0.603 (0.558)	-0.165 (0.168)	-0.268** (0.103)
Recreational Dispensaries	-0.0355 (0.0677)		-0.0436 (0.0729)		-0.0130 (0.0129)	
Unemployment	-0.000271 (0.000180)	-9.91e-07 (0.000102)	-0.000364** (0.000151)	-0.000107 (8.92e-05)	-2.80e-05 (3.13e-05)	
CPI Alcohol	5.460*** (1.944)	4.168** (1.755)	4.562** (1.824)	3.542** (1.586)	0.642 (0.432)	0.609 (0.439)
Constant	-1,118** (455.9)	-760.0* (386.0)	-1,038** (423.8)	-778.5** (343.8)	-119.3 (101.1)	-114.3 (94.93)
Observations	59	70	59	70	59	59
R-squared	0.965	0.977	0.974	0.981	0.972	0.971

Robust standard errors in parentheses  
\*\*\* p<0.01, \*\* p<0.05, \* p<0.1



## Results 1

In the first set of regressions, three dependent variables were analyzed: monthly recreational sales, the monthly sales spread between the recreational and medical market, to take into account possible customers turning to the medical market to avoid taxes, and revenue from the Marijuana Sales Tax. For each dependent variable in this set, two regressions have been run: one with most of the independent variables available, and an optimal regression, keeping only the variables estimated with relative precision. The independent variables used include: a set of monthly dummies, a tax change dummy to track the effects of the tax change, grocery retail sales data, single family housing sales, consumer price indexes for tobacco and alcohol, the producer price index for transportation of freight, unemployment data for Colorado and the number of recreational dispensaries. Among the variables that have been collected but not used in the regression analysis, median market price stands out. Because of the lack of monthly pricing data, which reduces the number of observations from 70 to 16, including this independent variable causes too much error in the analysis.

Looking at the first, non-optimal, regression run on monthly recreational sales, it appears that the tax change had a positive, but not statistically significant, coefficient with recreational sales. This result, while not significant, supports the hypothesis of legal market customers not being particularly price sensitive. Even in the second regression, removing the some of the variables with the highest error, the 5% tax increase had a positive (2.863) but not significant effect on recreational. Still, a positive coefficient between the tax change and an increase in sales shows that tax elasticity, equivalent to price elasticity in this case, in the recreational cannabis market reflects the one of a quasi-luxury good, or Veblen good. In fact, as prices increase, demand does too, suggesting that cannabis and cannabis products are a luxury good. High prices,

limited availability, barriers to entry and brand-focused marketing strategies all have contributed to this shift, assuming that when cannabis was only available in the unregulated market, it did not behave in such way. As previously mentioned, it is crucial that we also look at the effect of the tax change on the difference in sales between the recreational and medical market, to account for customers churning to the untaxed market. As expected, the effects of the tax change are larger on the markets' spread than on the recreational sales only, showing a large and positive coefficient with the spread of 4.661 in the general regression, and 4.268 in the optimal regression. Both results are not statistically significant, however they do suggest that tax increases could potentially push customers to the medical market, leading to a loss in potential tax revenue.

Regardless of customers churning, tax revenue is still positively correlated with the tax change. The optimal regression shows a statistically significant ( $p < 0.01$ ) coefficient of 4.697. This results suggests that the cannabis market is still in the left side of the Laffer curve. The cannabis market not only responds well to tax increases, bringing in more tax revenue for government programs, but it could also sustain further tax increases, at least in Colorado. It is important that we contextualize these results; Colorado is a more mature market that features low prices. Even with a 5 percent tax increase, Colorado's recreational customers still pay prices that are competitive with the unregulated market, making them less likely to churn away from the legal market. That's why these conclusions should not be extended to states with a shorter history of legalization. In these states, growers have not had the time to achieve economies of scale, and have to pass supply side costs to customers. High prices lead customers to be more likely to go back to the unregulated market. These states, in my opinion, are less capable of sustaining tax increases without losing customers and potential tax revenue. Still, these results

show that more mature markets, like Colorado and California, respond positively to tax increases, and could sustain higher taxes without sliding to the right side of the Laffer curve.

Results from the first set of regressions partially confirm the hypothesis regarding alcohol being an economic substitute for cannabis. Results from the general regression show that increases in the price of alcohol are positively correlated (5.460) with higher recreational marijuana sales. This result is statistically significant in both the general regression ( $p < .01$ ) and the optimal regression ( $p < 0.05$ ), which also features a positive coefficient of 4.168. Simply put, when alcohol becomes more expensive in Colorado, people switch tend to switch to cannabis. This is confirmed also when looking at the spread between the recreational and medical market. In this case, the effects on the spread are still positive and significant, but smaller. This smaller effect on the difference between the two markets could be explained by the buying behavior of medical customers. Logically, those who use cannabis as a medicine, are probably less inclined to change their buying habits based on the price of alcohol; they would buy weed regardless. However, the effects are still positive, suggesting that a portion of medical customers is substituting away from alcohol when it becomes more expensive. My theory is that the medical market is partially comprised of recreational customers who favor the market's untaxed prices, exposing the untaxed market to fluctuations due to changes in the price of alcohol. Lastly, looking at how price changes in alcoholic beverages influence cannabis tax revenue, it appears that effects are positive (0.642 and 0.609), but smaller and not significant. This is not surprising, since a shift in tax revenue is a secondary effect of changes in prices of alcohol.

Results are not as clear for tobacco. All of the regressions, regardless of the dependent variable, show small, and not significant, negative coefficients. The impact of an increase in tobacco prices on recreational sales is -0.0632, and on the markets' spread -0.0950. Coefficients'

signs suggest that tobacco is a partial complement of cannabis, possibly because it is used as a cheap filler. Still, the effects are too small and with too much error to reach significant results, which led to the decision of removing the CPI of tobacco as an independent variable in the optimal regressions.

The cost of transportation of freight was added to account for potential supply costs. Because cannabis has not been legalized at the federal level yet, growers need to find a secure way to transport the product without utilizing federal roads. This could potentially drive costs up, and negatively impact sales. Two regressions confirm the hypothesis with significant results. The optimal regression on recreational sales confirms that transportation costs have a large negative effect on sales (-1.973,  $p < 0.01$ ). This effect is large enough to have spill-over secondary effects on tax revenue, which is also negatively correlated with increases in costs of transportation, but with a smaller magnitude (-0.268,  $p < 0.05$ ). Potentially, this shows that federal legalization, and a decrease in costs of transportation, particularly for cannabis, could benefit both sales and tax revenue efficiency.

Through data layering, several variables, such as unemployment, grocery sales, and sold housing listings were added to the data set with the purpose of accounting for supply and demand factors, ultimately making results more accurate. Not much can be deduced from the coefficients of these variables, since results are miniscule. Unemployment presents a statistically significant result in only one regression: a small and negative coefficient with the recreational-medical spread (-0.000364,  $p < 0.01$ ). Both retail grocery sales and sold housing listings show coefficients close to zero with each dependent variable, but with high degrees of statistical significance. This shows that while these variables do not influence the cannabis market, they increase the accuracy of this economic model.

These results, and their contextualization in simple economic terms, are one of first attempt at characterizing cannabis as an economic good rather than a drug. Acknowledging the quasi-luxury nature of cannabis, and its low tax elasticity, can inform future taxation in the market. Also, observations on the effects of alcohol and transportation prices on the cannabis market can and should inform better economic models and regulation. Furthermore, results on the possible negative effect of the costs of transportation on tax revenue, should highlight one benefit of federal legalization: lower supply side costs can lead to lower prices, lower prices help with customer retention and acquisition in the legal market, which could lead to an increase in tax revenue.

While Durban Watson statistics don't show signs of positive autocorrelation (Appendix A), when observing the R-squared values of the regressions run they appear to be high. While high R-squared values are usually a positive in econometric research, values this high were not expected. Ranging from .965 to 1.00, the reported R-squared values could be highlighting an underlying common time trend of a growing economy. In order to validate these results, it was decided to run the same regressions on the monthly difference of each variable, detrending the dataset.

<b>TABLE 2</b>	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	Diff. Monthly Recreational Sales	Diff. Monthly Recreational Sales	Diff. Monthly Sales Spread	Diff. Monthly Sales Spread	Diff. Marijuana Sales Tax Revenue	Diff. Marijuana Sales Tax Revenue
Tax Change Dummy	-0.170 (2.183)	-0.304 (2.255)	-0.350 (1.873)	-0.489 (1.941)	0.198 (0.408)	0.119 (0.358)
Diff. Grocery Sales	0.00506*** (0.00169)		0.00435*** (0.00143)		- 0.000694*** (0.000236)	- 0.000618*** (0.000200)
Diff. Sold Listings (Single Family)	0.00252*** (0.000784)	0.00229*** (0.000836)	0.00130** (0.000645)	0.00129** (0.000632)	-9.03e-05 (0.000124)	-8.25e-05 (0.000116)
Diff. CPI Tobacco	-0.170 (0.117)		-0.181* (0.107)		0.0150 (0.0358)	
Diff. PPI Transportation	-1.756 (1.778)	-1.919 (1.552)	-1.104 (1.461)	-0.877 (1.250)	0.00902 (0.306)	-0.0498 (0.317)
Diff. Recreational Dispensaries	0.0634 (0.0933)		-0.0114 (0.0737)		0.0418* (0.0248)	
Diff. Unemployment	-25.39 (387.9)	7.188 (348.1)	-37.08 (342.5)	-45.73 (302.4)	10.93 (88.28)	
Diff. CPI Alcohol	2.791 (2.140)	2.797* (1.531)	2.984 (1.856)	2.419* (1.359)	0.0742 (0.466)	0.0741 (0.476)
Constant	1.290 (1.458)	1.011 (1.125)	1.662 (1.212)	1.120 (0.963)	-0.0570 (0.290)	0.227 (0.179)
Observations	59	70	59	70	59	59
R-squared	0.364	0.176	0.314	0.111	0.095	0.057

Robust standard errors in parentheses  
\*\*\* p<0.01, \*\* p<0.05, \* p<0.1

## Results 2

In order to detrend the data and check the results of the first set of regressions, the same regressions were run on the monthly differences of each variable. Since this second set of regressions was introduced in order to confirm previous results, I will focus only on differences between the sets.

The previous results showing a substantial positive coefficient between the tax change and recreational sales and the recreational-medical spread, now, observing the differences of each variable, appear to be small and negative. These results, still, are not statistically significant. While this regression does not confirm that marijuana behaves like a luxury good, it still shows, with such small coefficients, the tax change has close to no direct impact on sales, still supporting the argument for the quasi-luxury nature of cannabis products. Also, the regression run on tax revenue confirms a positive correlation with the tax change, confirming the conclusions derived from the first experiment

The most significant result we obtain from detrending the data is for tobacco. The previous regression did not confirm the hypothesis of tobacco being an economic complement of cannabis with statistical significance. Now, the price of tobacco has a significant ( $p < 0.1$ ) negative coefficient (-0.181) with the recreational-medical sales spread, confirming the original hypothesis.

This second experiment also confirms, with strong, positive, and significant coefficients, that alcohol does, in fact, behave like a substitute for cannabis. These results come from the optimal regressions run on sales and markets' spread, respectively showing a coefficient of 2.797 ( $p < 0.1$ ) and 2.419 ( $p < 0.1$ ).

When looking at the effect of the PPI of transportation on the three dependent variables, results match the magnitude and direction of the results from the first experiment; however, without statistical significance. Unemployment also remains uncertain, showing mixed results with significant error.

Ultimately, this second experiment partially confirms the results from the first set of regressions, however not without some limitations. Even if detrended, the data might present some degree of autocorrelation, as exposed by the Durban Watson statistics (Appendix B).

### **Considerations**

When looking at the research results it is important to consider some of the limitations of the econometric analysis. Most of the limitation can be summarized by a common problem: lack of data. Conducting research on the cannabis market has a lot of barriers. The lack of federal legalization leads to each state to adopt a different approach to policy and regulation. The lack of accessibility to data for different states did not allow the econometric portion of this research to expand beyond Colorado. Drawing conclusions from only one state does not give a full view on the American cannabis market. However, it allows for a cross state approach. The remainder of this research will attempt to contextualize what we were able to learn from Colorado's data to a completely different cannabis market: Illinois.

Lastly, another limitation to these results is the lack of access to data on the unregulated market. Especially after establishing that cannabis behaves like a quasi-luxury good, it is crucial to consider who buys legal-recreational cannabis. The answer is, after looking at pricing, "those who can afford it." Therefore, it is essential for future economic research on cannabis to understand how and to what extent cannabis users go back and forth between the legal and illegal market, especially after a tax increase.



## **V. Qualitative Approach: Illinois**

### **The Need for a Qualitative Approach**

The econometric analysis allowed me to understand the basic parameters of the market and its dynamics. However, because of the broad range of approaches to cannabis legalization, several questions are raised about how these results, especially the quasi-luxury nature of cannabis, can be applied to different states. As previously mentioned, Illinois and Colorado are entirely different markets. While Colorado is a more mature and developed market with unlimited licenses available, Illinois' recreational market was only opened as of January 2020, and it is characterized by several caps on the number of licenses available to growers and distributors. Through in-person interviews of a Chicago dispensary owner, a cannabis professor at Oakton Community College, and a cannabis consultant, conducted in Chicago thanks to the support of the Office of Undergraduate Research at Duke University, it was possible to collect further information on licenses, customer preferences, differences between the recreational and medical program, supply shortages, regulation, and tax revenue programs, including reparations on the War on Drugs.

### **Licenses and Vertical Integration**

The first difference between Colorado and Illinois' cannabis markets is that the first is an unlimited license market, and the second is capped. Illinois, in its first year of recreational legalization, decided not to oversaturate the market with recreational dispensaries, and opted to give priority to the 55 existing medical centers to also sell recreational cannabis. While not all medical dispensaries wanted to opt into recreational sales, and others did not meet application requirements, many expanded to the new market. In the meantime, the state opened applications for recreational only dispensaries, allowing 75 new businesses to enter the market after the first

year of activity. The state has also opened license applications for craft growers, manufacturing, and transport (Fix, 2020). The opening of applications did not come without barriers and regulations. Applicants could pick from a restricted number of locations and had to maintain minimum distances from schools, residential areas, and other dispensaries.

Furthermore, Illinois is one of the first states to introduce equity programs in their license applications. The government of Illinois placed concessions on the districts where people have been disproportionately affected by cannabis criminalization. To qualify, dispensaries must have a majority owner who has lived in one of the approved districts for at least five of the last ten years, has been arrested for a minor cannabis-related offense, or is part of an “impacted family.” This program extends to employees; if applicants have more than ten people, at least half of them must live in an impacted area or have been charged with a cannabis offense. Social equity applicants get an extra 50 points on the 250-point scale on their application evaluation and get a discount on application fees. The application fee for non-social equity applicants is \$5,000, plus \$60,000 for the first two years if they are awarded a license. However, Social equity applicants pay only \$2,500 for fees and \$30,000 if they are awarded the recreational license (IDFPR, 2020). While interviewing Steve Fix, in charge of dispensary operations at GreenGate Chicago (a medical only dispensary) and cannabis professor at Oakton Community College, he highlights how hundreds of social equity applicants applied thanks to these concessions. This also applies to growers that, in possession of a growing medical license, were given priority to start growing recreational products. Furthermore, entities in possession of a growing license also have the right to own up to five dispensaries (Zises, 2020). All interviewees strongly emphasize that because of this regulation, the market actually has fewer players than one would think. Many growers are, in fact, owned by the same large corporations that are also buying into many dispensary businesses.

Ultimately, having large corporations in control of the supply chain, owning both growers and distributors, leads to vertical integration and the market becoming an oligopoly. This market dynamic is affecting independent dispensaries which, Zises says, struggle with supply and are forced to consider becoming part of a grower's dispensary portfolio. Because of this market dynamic, pre-existing supply and inventory issues are worsened.

### **Shortages**

In any new cannabis market, finding sufficient supply can be an issue. In Illinois, problems started arising with the medical program. As new medical conditions started being included in the medical marijuana approved list, demand in the legal market skyrocketed. When the government included Post Traumatic Stress Disorder in the medical marijuana program, dispensaries started seeing the first signs of shortages, as more individuals were allowed to be customers. When the market opened for recreational sales on January 1st, 2020, the shortage problem ramped up, as every adult became a legal customer. Demand for recreational cannabis had people lined up for hours outside of dispensaries. The main issue, as the experts' interviews highlight, is that recreational customers are taking the product away from medical customers.

Because all of the recreational dispensaries in Illinois as of 2020 are converted medical dispensaries, most businesses made the decision to limit access to recreational marijuana to favor their medical patients. To do so, most dispensaries are open for recreational sales only on certain days and times. Some dispensaries go to the length of releasing limited daily access tickets to recreational customers to cap demand and protect medical patients' medicine. Another way dispensaries try to control for shortages is product selection. Dispensary33, for example, a medical and recreational dispensary, makes only two strains, of the dozen strains they have, available to recreational customers. Calling several recreational dispensaries in the Chicago area,

it becomes evident that the majority of them do not offer any flower products (loose flower or pre-rolls) for recreational customers. All of these measures have been enacted to ensure that medical patients have access to their medicine, but ultimately are a result of shortages. Zises claims that vertical integration is also to blame. Growers that also own dispensaries, especially in this limited supply market, have the tendency to prioritize fulfillment in their own stores when availability is limited. This leads independent dispensaries to be impacted more heavily by shortages than one's part of vertically integrated supply chains (Zises, 2020). This poses many questions about the future of the recreational market in Illinois. Talking with experts and visiting dispensaries leaves little doubts about demand. Seeing people lining up outside of Dispensary33 since early in the morning shows that demand is high. However, soon the number of dispensaries will more than double when the 75 new licenses are issued in May of 2020. Because growing facilities are not able to fulfill current demand, it is hard for dispensary owners to imagine how the limited supply will be shared across more distributors. Again, vertically integrated dispensaries will have an advantage when the dispensary market becomes saturated since they have direct access to growers.

These shortages do not seem to impact all products. As Steve Fix points out, most medical patients prefer flower products. Because this is also the most sought-after recreational product, the two markets heavily compete. This trend of customer preference for flower is not just a reality in Illinois. In Colorado, as outlined in the 2017 Market Update, flower constitutes 61.8 percent of total sales, with the second most popular product being concentrates, with a 27.3 percent share (Adam Orens, 2018). Some products are becoming more popular only in one of the sub-markets. Pens or concentrates says Steve Fix, are very popular among recreational customers but are not a preferred medical product. These preferences have led marijuana pens to become

the primary offering for recreational customers when flower is not available. Because the medical and recreational market are not competing over this product category, vape cartridges are not suffering from the same shortages.

## **Regulation**

Discussing these topics with industry insiders gives a perspective on the level of regulation in the market. Regulations cover store layout, payment methods, handling of inventory, and product information. Steve Fix also discussed how regulation is impacting dispensaries and customers. According to his experience, the government has heavily regulated irrelevant aspects of cannabis and disregarded the ones that can impact the health and safety of cannabis users. For example, Steve Fix showed during the interview the packaging of a popular cannabis brand for a flower product. On the back of the glass container, a label reads THC-A levels in the product. Fix points out that some brands decide to report THC-A levels, the acid form of THC, rather than THC levels. Growers prefer to report THC-A level rather than THC in order to market flower as a higher potency product. This information is somewhat misleading. Since part of the THC-A degrades during combustion, unlike THC, this tricks customers into thinking they are buying a more potent product than it actually is. The mislabeling is possible because the government of Illinois does not regulate how growers and product manufacturers have to label cannabis. Fix also shared how this is affecting some products more than others. When looking at different strains, and their different effects and properties, terpenes play an essential role. Terpenes are aromatic oils that color cannabis varieties with distinctive flavors and allegedly play a crucial role in differentiating the effects of various cannabis strains (Rahn, 2019). Terpenes have become one of the main ways cannabis products are marketed and differentiated from one another. In vape cartridges, however, instead of merely highlighting what

terpenes the strain naturally contains, non-cannabis derived terpenes are often added. Illinois does not regulate what can be added to concentrates and what cannot, and especially it does not regulate how to communicate this information to customers transparently.

## **Conclusions**

Overall the market in Illinois for recreational cannabis is new, and it still needs time to develop and mature. Because only former medical dispensaries are allowed to sell recreational cannabis, and supply cannot keep up with demand, the recreational and medical market are competing. Looking at the trajectory of the Colorado market, with recreational taking over the medical program in one year, it can be expected that the same dynamic will develop in Illinois. With new licenses about to be awarded to recreation-only dispensaries, this could be the first step towards this trajectory. One last aspect to consider is the real competitor of the legal cannabis market: the unregulated market. Both Steve Fix and Bryan Zises agree that unregulated cannabis, with its low prices, will define the future growth of the legal cannabis market in Illinois. Just like Colorado did, achieving economies of scale on the supply side and offering flower product at competitive prices, should drive the future of this market.

## **VI. Equity Programs and Reparations**

While Colorado used cannabis revenues only to fund education, Illinois took a much more progressive and varied approach. By establishing the R3 program and the goal of equity in the application process, the state acknowledged the long history of criminalization of this product. This research was purposeful in opening with the history of cannabis to illustrate the reason for this equity programs to exist and the need to acknowledge the past in order to inform the future of legalization at the federal level.

## **Licenses and Tax Revenue**

The idea of giving back to the communities affected by the War on Drugs is actualized through policy in two ways: access to licenses and tax revenue. The prime example is Illinois, which has both an equity program in its license application and a reparations fund financed through cannabis tax revenue.

Licenses have been used for equity programs in other states before Illinois announced their intentions, but with little success. The city of Los Angeles attempted to add an equity program in the application for new licenses but faced much criticism when it did not meet expectations (Levin, 2020). The truth about giving back to communities affected by economic and government-induced hardships is that there is a necessity to put a price tag on it. Opening up access to licenses can be a game-changer to diversify the predominantly white-owned cannabis market. However, without knowing how much a license is worth, it is inaccurate to call it “reparations.” No one has talked about the actual economic value of owning a cannabis license. One way to establish the value of a license, is to consider the discount that social equity applicants receive on fees. However, a cannabis license gives receivers access to an almost untapped and growing market, and therefore it also gives access to a slice of the market revenue. This true economic value should be included in the estimation of the value of a license. The value of a dispensary license is equal to the present value of its profits. In this case, profit is equal to revenues net of all costs, including license fees. Following present value theory, we let Profit stand for next year’s profit from the dispensary,  $g$  for growth rate of that profit, and  $r$  be the proper discount rate for a dispensary business, then the value of a license is given by:

$$Licence\ Value = \frac{Profit}{(r-g)}$$

In theory, applying a dividend discount model, we can obtain the value of a license. However, the lack of federal regulation causes the value of a license to vary by state. For states

like Colorado, which could have an unlimited number of licenses at any given time, calculating the exact value of a license is a challenging feat. Without knowing the market's growth rate and the effects of an increase in the number of dispensaries on profitability, it is impossible to make accurate estimations and build robust social-equity programs. In Illinois, instead, having a capped license market can help to estimate the real value of a license more accurately. Still, it is critical to consider how vertical integration could reduce the efficacy of the license equity program. In an oligopolistic market, the licenses of distributors integrated with growers would be exponentially more valuable than the licenses of independent dispensaries, which struggle keeping up with demand. License equity programs offer a great approach to fixing the lack of diversity in the market and improve access for individuals that have been previously affected by the criminalization of cannabis. However, without making accurate estimations on the value of each license, and with states like Illinois not regulating their vertically integrated market, these efforts could all be in vain.

The second way states have tried to repair the damage made by the War on Drugs directly through tax revenue. Illinois has created the *Restore, Reinvest, and Renew* program, which, fed by 25 percent of tax revenue from the cannabis market, “grants funds to community organizations that support economic development, provide violence prevention and reentry services, and offer youth development and civil legal aid to individuals” in areas disproportionately affected by the War on Drugs (Illinois Criminal Justice Information Authority, 2020). Only for the 2020 fiscal year, a set amount of \$10 million has been established to fund the R3 program. For 2021, it is estimated that \$25 million will be extracted from the cannabis market for R3 program, and \$125 million when the market reaches maturity (Quig, 2020). While the program received both a lot of support and media coverage, when asked about



it, the interviewees in Chicago expressed doubts. The long history of corruption in Illinois has prevented the two cannabis experts from believing that such a program will ever be fully implemented (Zises, 2020) (Fix, 2020). This underlying skepticism regarding reparations programs is not optimal, but it does not undermine its functionality.

It is critical to acknowledge both the strengths and weaknesses of this approach to reparations. The market's high revenue and promising projections for the future constitute the basis for an excellent source of tax revenue. Market projections show that the cannabis market could be worth \$29.7 billion (New Frontier Data, 2019). In the presence of a statewide approach to collect funds for reparations programs, and by maintaining similar rates to Illinois' 25 percent, it would allow raising \$7.42 billion across the United States. Fundamentally, the research world focuses on estimating a comprehensive figure that represents the damage from the War on Drugs. Understanding the extent of the reparations needed can inform a more precise tax policy and an effective plan to collect said sum, also from the perspective of future federal legalization. Some of the results from this research can both inform tax policy and support the reparations program. The results of this research show that cannabis behaves like a quasi-luxury good, with both meager price and tax elasticity on a tax increase of 5 percent. For policymakers, this could mean that more revenue can be collected from the cannabis market, with little impact on customer demand. In the case of federal legalization, even adding a 5 percent federal tax would have little impact on demand but allow the government to raise billions of dollars in reparations.

However, there is one criticism to make to this methodology of collecting fund reparations. Any money raised through a direct sales tax is ultimately placed on customers and, therefore, cannabis users. This raises an ethical question. Is it fair to collect money to repair the damages made by the War on Drugs, pulling from the pockets of marijuana users, who might be

part of the group who deserves reparations in the first place? This being economic research, it is not my goal to establish what is the most ethical way to raise such money. Nevertheless, now that we know that the market can indeed be used as a source of reparations and that it is a market that can endure extensive taxation, we need to ask ourselves how we will raise this money, and what is the fairest and effective way to do so. Ultimately reparations are needed, and the cannabis market is economically an excellent place to draw funds from.

## **VII. Discussion**

One of the fascinating aspects of this research is studying how a plant that has been criminalized for over a hundred years has not only become a product, but it has started behaving like a luxury good. Not only did society go from marketing cannabis at street corners to billboards, but cannabis itself is starting to behave like its being advertised, like a luxury good. It is a matter of time until cannabis will be sold as part of an experience, and not solely as a product. Envisioning what a mature cannabis market might look like in the U.S. is strictly contingent on the federal legalization of this plant. Still listed as a Schedule I drug, cannabis cannot be transported across states, or on federal highways, increasing supply costs and placing too many barriers for this market to reach its full economic potential.

I want to acknowledge what this research represents. Accessing data on cannabis is currently a hardship. Many U.S. states have too short of a history of legalization to provide meaningful data. Of the ones that have been first in legalizing cannabis, many still do not share their data. Collecting and combining a wide range of data on the cannabis market was a great challenge, but it is also a first in the field of research economics. Still, this data set, while a step forward compared to previous research, does have some limitations. Secondary cannabis

markets, like the hemp and CBD market, have not been included in the data set due to a lack of time. Also, a lack of data on the unregulated market did not allow to track how tax changes influence customers' preferences between the legal and unregulated market. Including these aspects should be a focus of future research.

This paper is not just about an econometric experiment. After outlining the mostly unknown history of cannabis criminalization and the effects of the War on Drugs earlier in this paper, we cannot forget the need to repair the damage made through cannabis to many communities across the United States. Reparations should be in direct association with the term "cannabis market." As more researchers get access to cannabis data, and to cannabis itself, many fields of research need to come together in order to understand how to regulate cannabis and its market. More questions need to be answered. Specifically, economic research should focus on understanding how the two rival markets, the legal and the unregulated markets, will co-exist and develop over time. The unregulated market, or the illicit market as Newfrontier Data names it, was worth \$64.3 billion in 2018 and is projected to decrease to \$57.3 billion in 2025. This negative future projection is still much higher than the legal market's projection for the same year (\$29.7 billion); calling for economic research to be conducted on the two markets, but specifically on how to help people switch from the unregulated market to regulated, tested, and legal cannabis regardless of its higher cost. Also, keeping market revenue high is conducive to the success of financing programs that put social equity first. Ultimately, it is key to understand the true wealth of the cannabis market is in giving back to the communities that have been impacted by its criminalization.

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### IX. Appendix A

Durbin Watson Statistic

Regression 1	Regression 2	Regression 3	Regression 4	Regression 5	Regression 6
(10,59)	(7,70)	(10,59)	(7,70)	(10,59)	(7,59)
1.473328	1.52545	1.219187	1.242288	1.836577	1.701082

### X. Appendix B

Durbin Watson Statistic

Regression 1	Regression 2	Regression 3	Regression 4	Regression 5	Regression 6
(9,59)	(6,70)	(9,59)	(6,70)	(9,59)	(6,59)
2.242955	2.261062	2.179397	2.225391	2.448337	2.486305